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Gulf of Mexico Shrimp Fishery Recruitment Overfishing Definition Workshop 2

BY

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INTRODUCTION

The Gulf of Mexico Fishery Management Council (GMFMC) requested that the Council's shrimp stock assessment panel and a representative from each of the five states surrounding the Gulf of Mexico convene to review the scientific definitions of overfishing, for each of the shrimp species in the management unit of the Fishery Management Plan (FMP), that were developed at the previous workshop (Klima et al., 1990). The tasks assigned by the GMFMC included: 1) review the current definitions of overfishing for the shrimp stocks; 2) recommend changes, if needed, to the current definitions of overfishing; and 3) recommend action that might be taken if overfishing levels are surpassed in any of these stocks. Although there are four shrimp species in the current FMP (brown, Penaeus aztecus; white, P. setiferus; pink, P. duorarum; and royal red, Hymenopenaeus robustus), only the three Penaeus species were discussed at the workshop.

On February 9-10, 1993, the small group of scientists convened at the NMFS Galveston Laboratory to undertake the tasks requested by the GMFMC. Those present from the shrimp stock assessment panel included: Wade Griffin (Texas A&M University), Jim Nance (NMFS Galveston Laboratory), Scott Nichols (NMFS Pascagoula Laboratory) and Phil Steele (Florida Marine Research Institute, attending for Robert Muller). The State representatives included: Terry Cody (Texas), Steve Heath (Alabama), Brandt Savoie (Louisiana), William Teehan (Florida) and Thomas Van Devender (Mississippi). Nonvoting individuals present at the meeting included: Terry Leary (GMFMC Staff) and Julius Collins (Chairman of the Council's Shrimp Management Committee). Minutes of the meeting were recorded by GMFMC secretarial staff.

This report summarizes the findings of the two day workshop and provides recommendations from the working group. All recommendations contained within this report were reached by unanimous decision of the nine members of the working group.

RECOMMENDATIONS

Index Type

The group determined that number of parents, based on a VPA analysis (Nichols 1984), is the preferred index to establish the definition of overfishing for the three Penaeus species. A statistically significant parent stock - recruitment relationship is not apparent for any of these three shrimp species. The statistically poor relationship between parents and recruits comes from the variable effects of the environment on the survival of the young shrimp stages from spawning until entrance into the fishery. This variability in survival of young shrimp stages clouds the stock - recruitment relationship and makes it difficult to quantify the underlying association between parents and recruits. The parent number provides a measure of reproductive potential, but not reproductive success. Maintaining adequate reproductive potential should be considered in defining overfishing, therefore a parent stock index was chosen.

Other index types such as recruitment and catch per unit effort were discussed, but it was felt that they did not provide as good an index as parent number. Recruitment is the measure of reproductive reality, but the values are greatly influenced by environmental conditions. CPUE is a measure of abundance, but its usefulness was limited since only nominal and not standardized effort is presently available for the calculations.

Parent Age and Spawning Season

The selection of the minimum age of parenthood and the length of the spawning period for the three species was discussed in detail. The four month spawning period for brown shrimp of November through February was retained from the previous workshop (Klima et al., 1990). It was determined that pink shrimp spawning was truly a year-round phenomenon, thus the twelve month July through June spawning period was also retained from the previous workshop. Since white shrimp postlarvae are usually not caught along the beaches of the U.S. Gulf of Mexico until mid-May, with most found during the June through July period (Baxter and Renfro, 1967),

the spawning period for white shrimp was changed from the five month period of April through August to the four month period of May through August.

Age sensitivity analyses, examining the relationship between total annual recruitment and monthly parent number during the peak spawning period, have been performed each year for brown and pink shrimp during the annual stock assessment research (Nance and Nichols, 1988; Nance, 1989). During most of the months examined, brown shrimp ≥age 7 months and pink shrimp ≥age 5 months usually showed the best statistical correlation with recruitment values. These were the age values selected during the first workshop (Klima et al., 1990), and they were retained during this second workshop.

For white shrimp, no age sensitivity analysis has been performed and during past research efforts all shrimp ≥age 5 months were included as possible parents during the recruitment - parent stock comparisons (Nichols, 1984). This ≥age 5 months group represented all the shrimp from the previous year that were left in the fishery during the spring of the following year and usually gave good correlation's (r^2 around 0.40) during the recruitment - parent stock comparisons. Since the GMFMC was having a difficult time understanding why ≥age 7 months was selected for brown shrimp and ≥age 5 months was selected for white shrimp, a comparison of white shrimp abundance at ≥age 5 months and at ≥age 7 months, during the selected spawning periods, was made during this workshop. Figure 1 depicts the differences between the two parent groups. Although, as expected with two more months of natural and fishing mortality, the ≥age 7 months levels are smaller than the ≥age 5 months levels, the trends are very similar. It appears from the data that either parent group could be used to predict the recruitment during the following year with equal success. With no apparent loss in predictability and to avoid further possible confusion, ≥age 7 months was selected as the new parent age for white shrimp. Biologically, this change should not interfere with the purpose of the overfishing definition (to alert the GMFMC that parent numbers have been reduced below a level that may not sustain recruitment), unless the age 5 and age 6 month old white shrimp parents have a spawning potential that greatly

exceeds the potential exhibited by the ≥age 7 month white shrimp. We have no data to support either argument.

It should be pointed out that parent levels for white shrimp are still higher than those shown for brown shrimp (Figure 2). This may perplex some individuals, but it should be remembered that some shrimp species simply have a greater reproductive potential than other shrimp species. For example, Penn and Caputi (1985) observed that tiger prawn (Penaeus esculentus) recruitment was impacted when spawning stock was reduced to about 40% of the virgin size. Yet, banana prawn (P. merquiensis) spawning stock size has been reduced to well below 10% of the virgin level without apparently affecting subsequent recruitment (Somers, personal communication).

Index Level

Since there is no indication of recruitment overfishing for brown shrimp as evidenced by high levels of recruitment (Klima et al., 1990), a parent stock level of 125 million was retained as the lower limit to define recruitment overfishing for brown shrimp in the Gulf of Mexico. This value is slightly lower than the 1983 level of parent stock which is the lowest observed value in the data set (Figure 3).

Since there is no indication of recruitment overfishing for pink shrimp, a minimum of 100 million shrimp was set as the lower limit for parent stock in the pink shrimp fishery in the Gulf of Mexico. This value is slightly lower than the value experienced during 1979 (Figure 4), and was retained from the first workshop. Only the post-1970 date was used to set the lower limit for pink shrimp. The data from 1960 through 1969 was excluded from the analysis since there has been a shift in the fishery to more northern areas since that time, and the parent stock values for the 1960's may have been underestimated because of this shift.

Since there is no indication of recruitment overfishing for white shrimp, a minimum of 330 million shrimp was set as the lower limit for parent stock in the white shrimp fishery in the Gulf of Mexico. This value is

slightly lower than the 1973 level of parent stock, which is the lowest observed value since the mid-1960's (Figure 5). Although the nominal figure is a change from the 600 million shrimp number set at the first workshop, the source of this change is based on using parents ≥age 7, not the on the same ≥age 5 month parents as in the previous recommendations. Thus, the change is in index scale, not in the substance of the recommendation. As during the first workshop, the minimum was set above the three early low points (1960 through 1962). It was concluded by the group that since present white shrimp nominal fishing intensity is twice the levels found in 1960 (Figure 6), recruitment overfishing may occur if these early 1960's parent levels were reached with current effort levels.

Level Alterations

It was the conclusion of the group that the parent index levels used in defining recruitment overfishing for brown, white and pink shrimp, are based upon the best scientific information. VPA analysis was used since this methods provides the fullest use of this 32 year data base. However, the question remains as to whether or not recruitment overfishing will occur if these selected overfishing levels are exceeded during a particular season. It was the recommendation of the group that the GMFMC provide a mechanism to allow the overfishing index level to change as new data becomes available. For example, if the parent numbers drop below the current index during a particular year, and then recovers the following year, a lower overfishing level could be considered by the GMFMC. However, if the level drops and does not recover the following year, then the GMFMC should consider convening the shrimp stock assessment panel to evaluate the situation.

LITERATURE CITED

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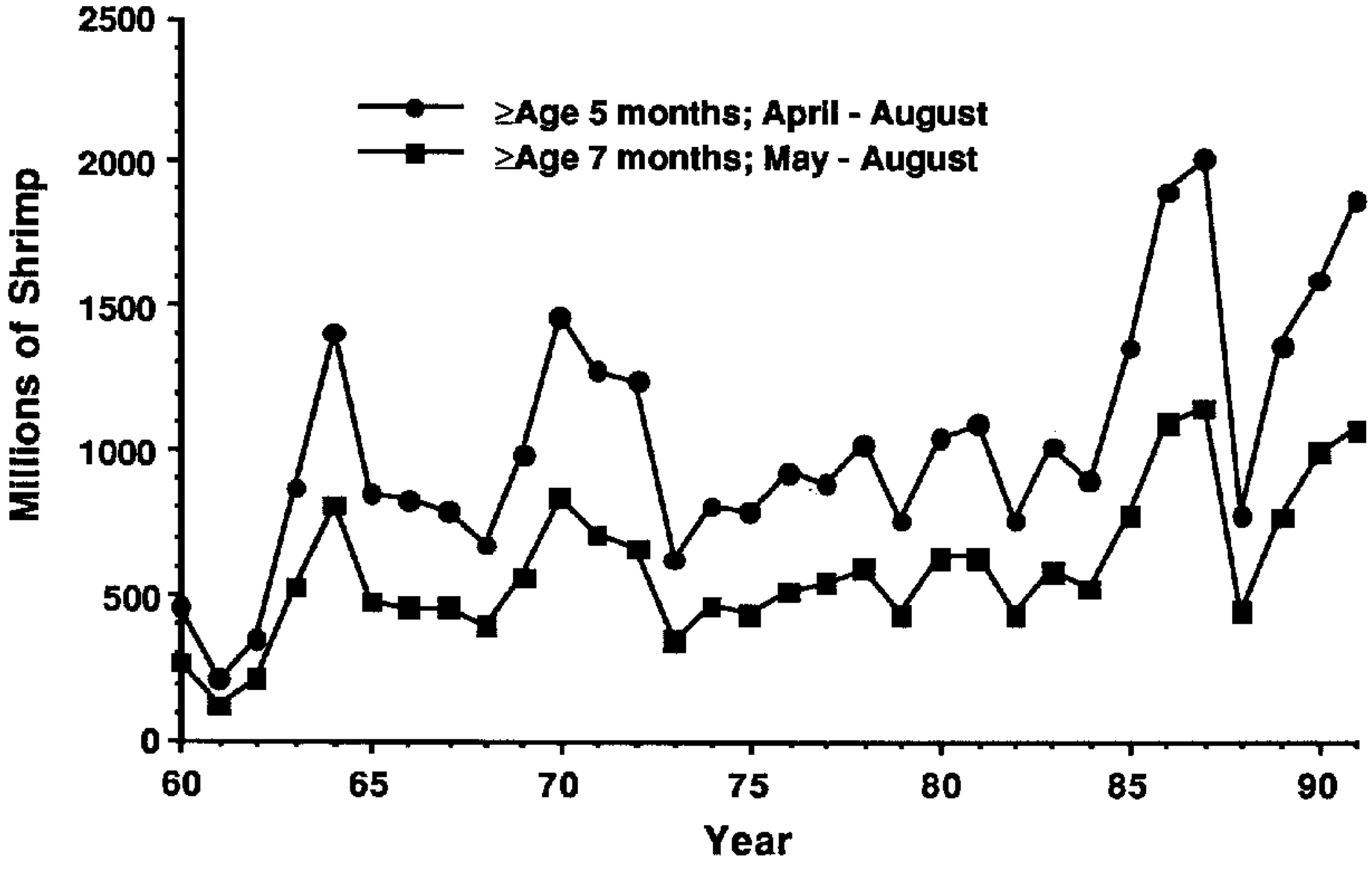

Figure 1. Numerical comparison of two white shrimp parent stock levels.

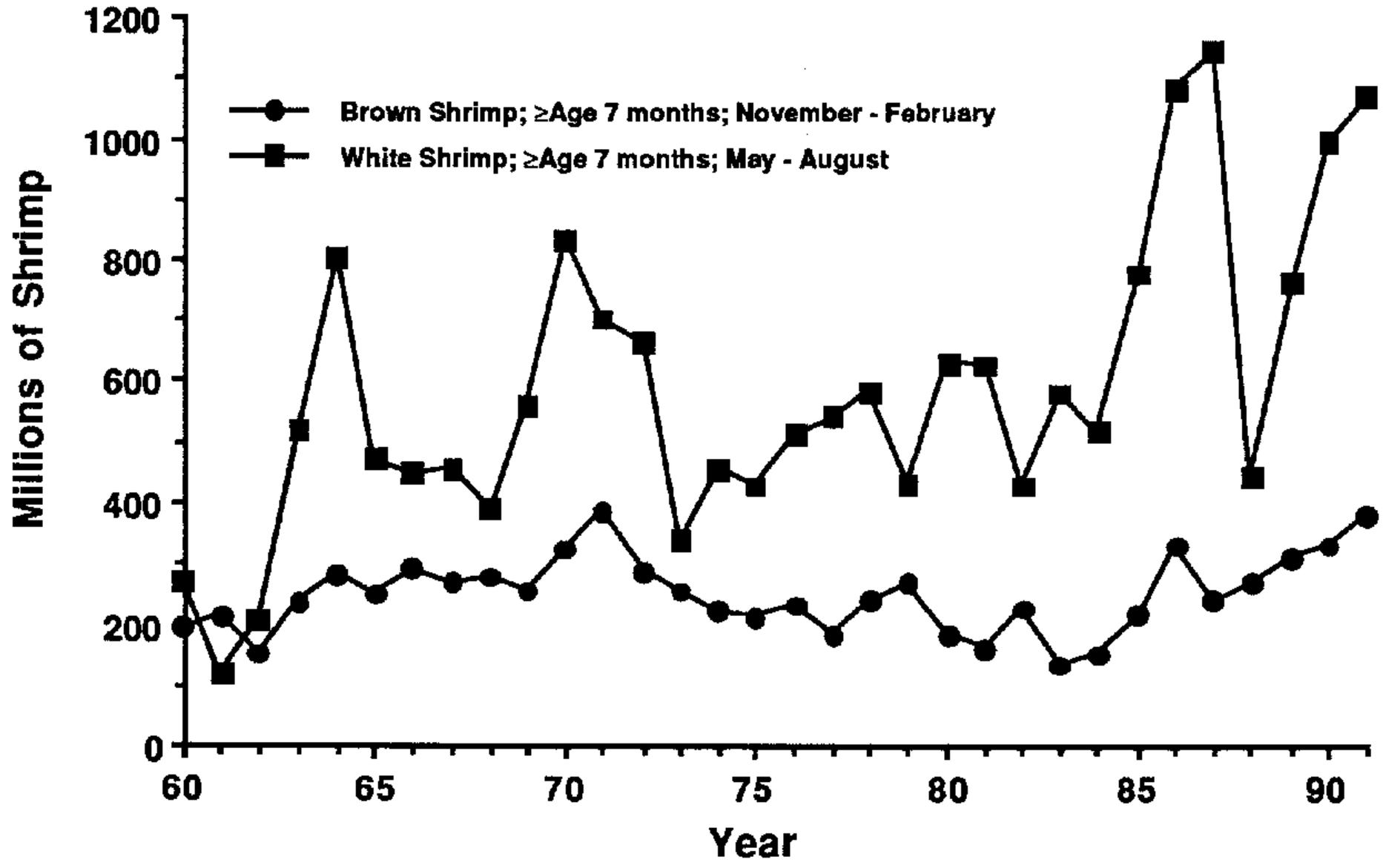

Figure 2. Comparison of brown and white shrimp parent stocks.

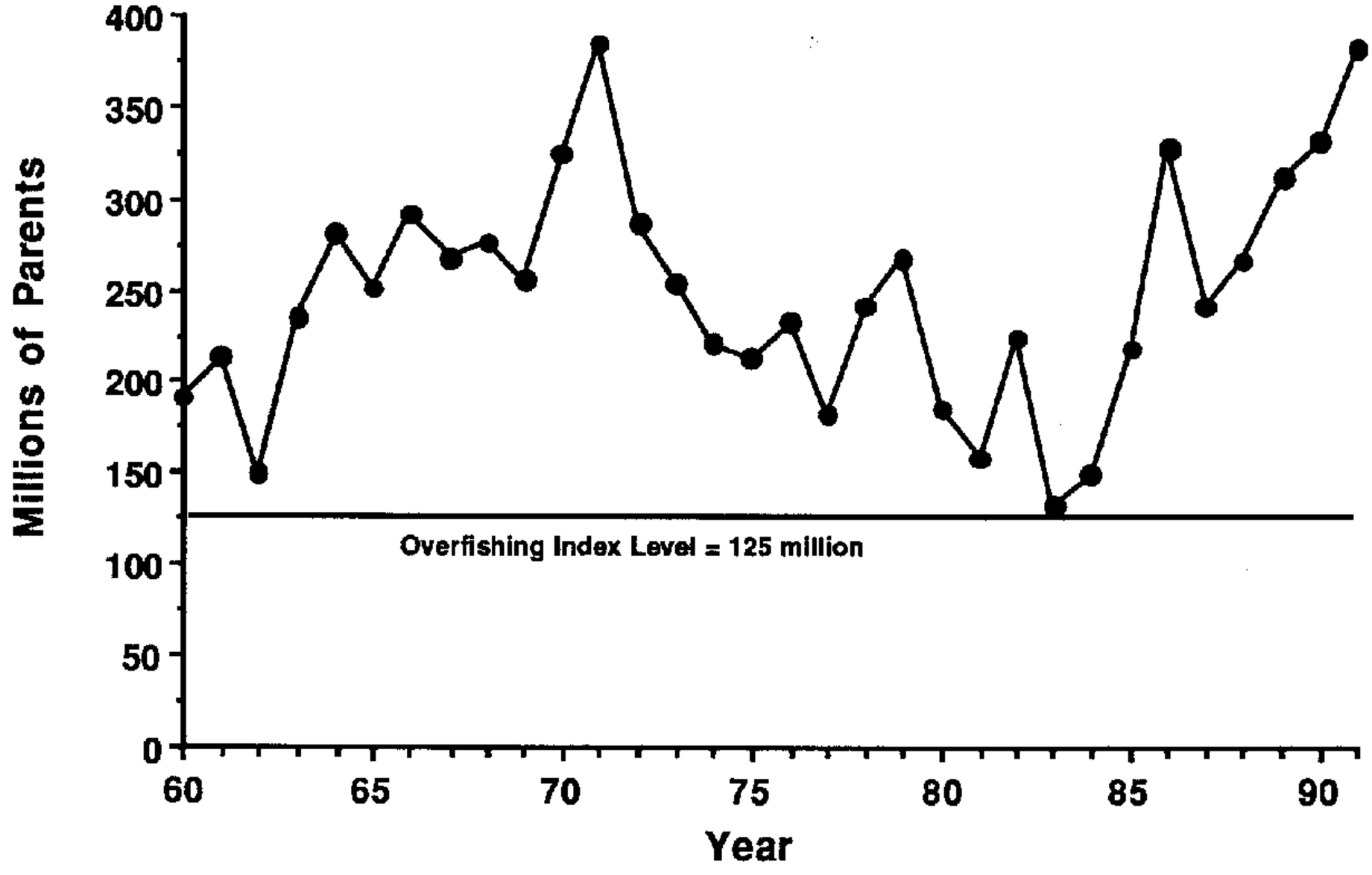

Figure 3. Brown shrimp recruitment overfishing index level (≥Age 7 months; November through February).

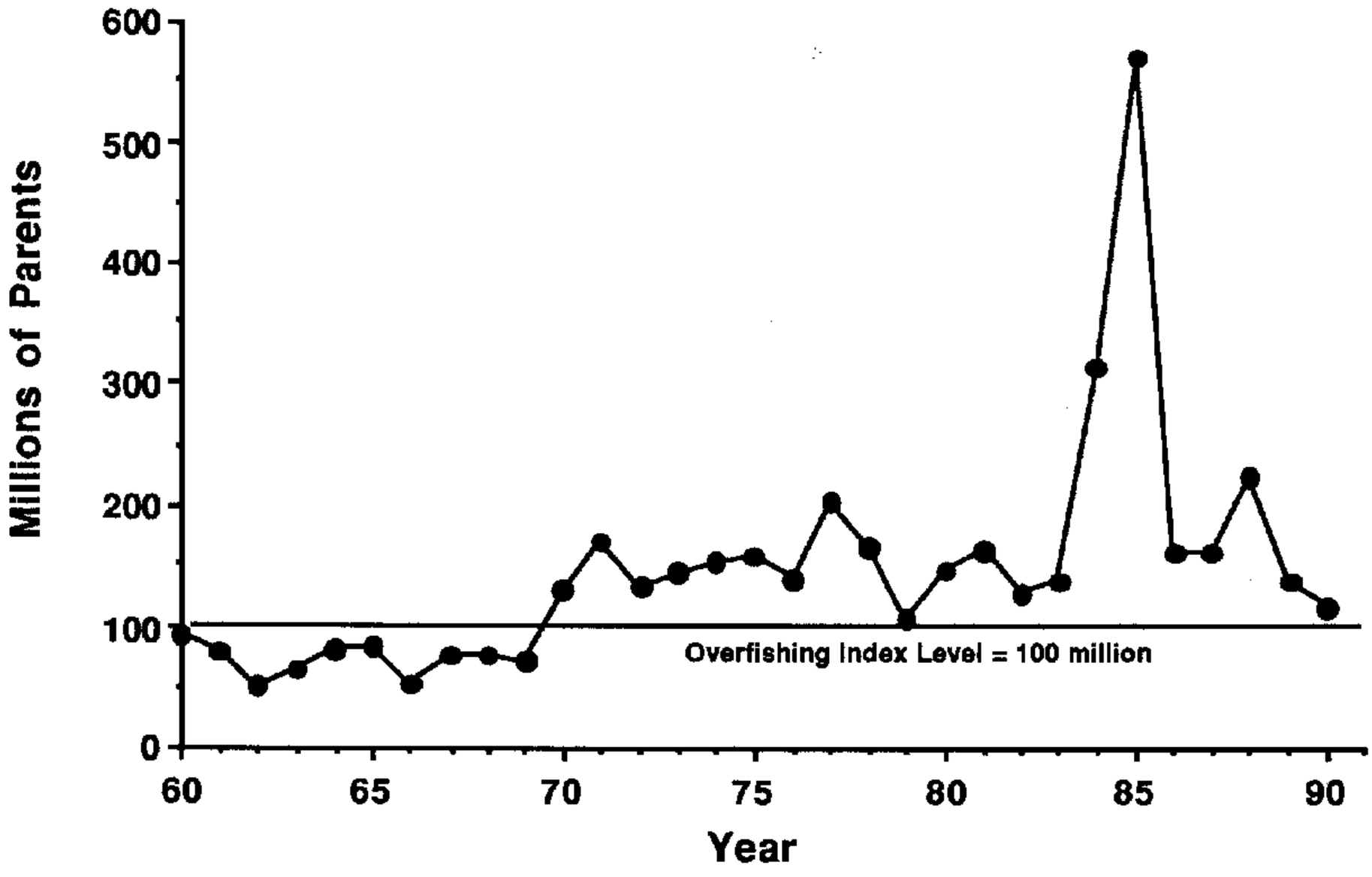

Figure 4. Pink shrimp recruitment overfishing index level (≥Age 5 months; July through June).

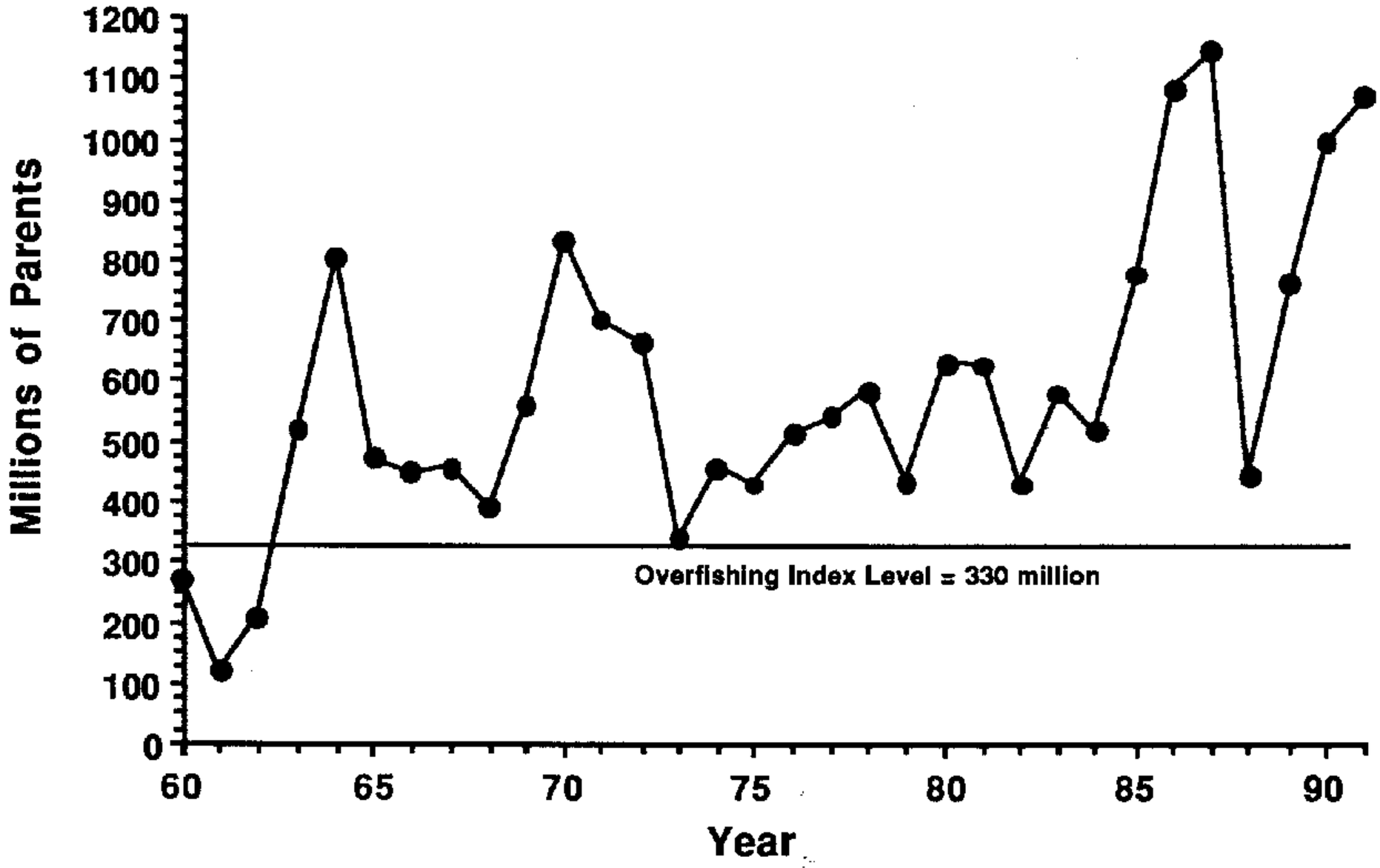

Figure 5. White shrimp recruitment overfishing index level (≥Age 7 months; May through August).

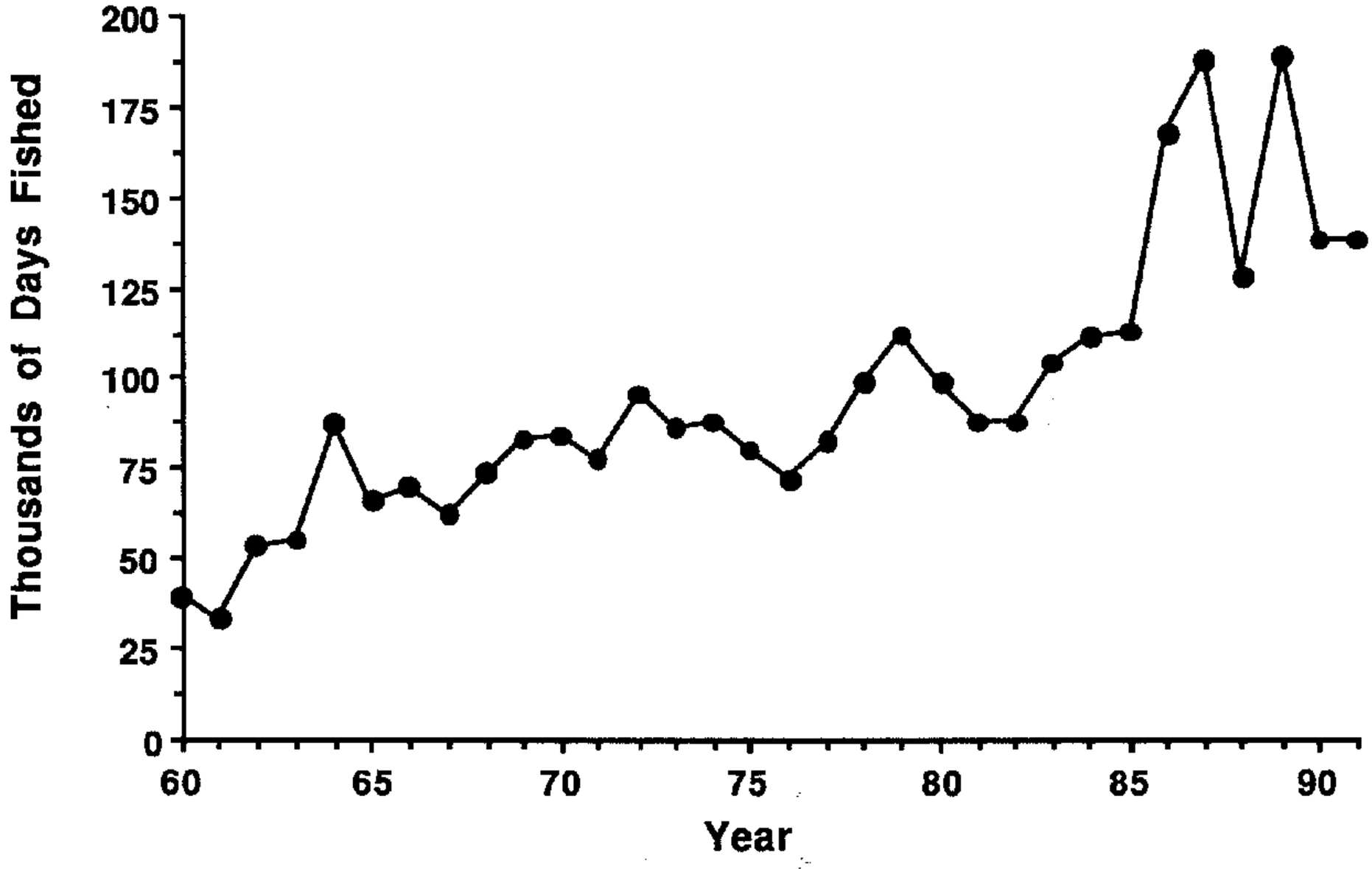

Figure 6. White shrimp total effort in the inshore and offshore waters of the Gulf of Mexico.